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The Instrumented Flux Return detector of the SuperB project: R & D studies and first results of the Fermilab Beam Test.

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SuperB is a next generation super-flavor factory which will be built in Italy with a strong international involvement. The project, recently approved by the Italian Government, and classified as one of the flagship projects of the Italian INFN, foresees the construction of a high intensity asymmetric electron-positron collider and of the related detector. The expected luminosity of $2 \times 10^{36} \text{ cm}^{-2} \text{ s}^{-1}$, a factor 100 higher than the present generation of B-factories, will allow the high statistic study of rare decays and, possibly, will show evidences of new physics.

Part of the SuperB apparatus is the Instrumented Flux Return (IFR). This detector, mainly devoted to the identification of muons and neutral hadrons, consists of $\sim 1\text{m}$ of iron interleaved by 8-9 layers of highly segmented scintillators. The detection technique is based on relatively inexpensive extruded plastic scintillator bars ($2.0 \times 4.0 \text{ cm}^2$ produced in the FNAL-NICADD facility). The scintillation light is collected thanks to 3 WLS fibers, which guide it to recently developed devices called Silicon Photon Multipliers used as photo-sensors.

The use of plastic scintillator as active material ensures reliability, robustness and long term stability while the high granularity and the fast response guarantee a good space-time resolution, extremely important to cope with the expected high particles flux.

At present two different readout schemes are under evaluation: a "double coordinate readout" where two layers of orthogonal scintillator bars provide both, the polar and azimuthal coordinate; and a second option, the "time readout", where the polar coordinate is measured, instead, by the arrival time of the signal.

In order to deeply understand the performances and possible drawbacks of the above techniques, a full scale prototype has been designed and built in Ferrara/Padova, and tested at the Fermilab Test Beam Facility (FBTF) in December 2010.

In the proposed talk, a comprehensive description of the IFR-related R & D studies will be presented.

In particular, we will focus on the results of the Fermilab beam test: performances, issues and future activities will be presented.

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